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RESEARCH ARTICLE

ASSESSMENT OF AGRICULTURAL EFFICIENCY AND PRODUCTIVITY: A STUDY OF HUGLI DISTRICT, WEST BENGAL, INDIA

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ABSTRACT

Today, India has been facing two most vital problems which are directly related to agriculture, the first one is to meet the swelling demand for food and other agricultural products, and the second is enervating the widespread poverty in rural areas by the ever increasing population. The good performance in agriculture can diminish levels of rural poverty and meet increasing demand of agricultural products (Ahluwalia, 1978). Agricultural productivity is a measure of the efficiency with which inputs are used in agriculture to produce an output. When a given combination of inputs produces a maximum output, the productivity is said to be at its maximum. The measurement of agricultural productivity enables a comparison of relative performance of farmers between farms, between the types of farming and between geographical regions. The comparison of productivity goes on to the heart of economic performance and can provide the guidance for planning and development decisions (Kravis, 1976). Present study confined to such an analysis of agricultural development in terms of efficiency and productivity of Hugli District, which is one of the agriculturally prosperous district in West Bengal due to the presence of Gangetic fertile alluvial tract, better irrigation facility and high demand of agricultural products in different agro-based industries. Besides measuring the level of efficiency and productivity at block level, an attempt has been made to find out the major controlling factors of overall agricultural system based on PCA analysis. Finally this work concluded to make some suggestions and management plans to enhance the agricultural output in terms of yield as well as money.

INTRODUCTION

Agriculture is not just a food providing machine but the backbone of the livelihood of 60% of people of India (Swaminathan, 2009). According to Datt & Sundharam (2009), agricultural growth has a direct impact on poverty eradication, health, nutrition of rural masses, national security and multiplier effect on entire economy. Agriculture is the largest sector of the nation as well as of West Bengal, which provides about one-fourth GDP, gives livelihood to more than sixty per cent of population and employs nearly 69 per cent of the total workforce (Ranganathan, 2003). Thus, the development of agriculture sector can serve up as a catalyst for rapid growth of whole economy (Maity and Chatterjee, 2006). The agricultural production is the effects of farming (Kostrowicki, 1964). In the field of geography, the concept of the agricultural efficiency measurement is not a new aspect. The term agricultural efficiency connotes the productivity of a particular unit of land. It is the scientific device to study the inherent fertility, productivity and capability of the land, so that its misuse and underuse may be checked by planning for future use. Agriculture is the backbone of Indian economy, but owing to the sedentary methods of cultivation and high pressure of population 'agriculture is not a business proposition for farmers, but living a way of life' (Nanavati & Anjaria, 1951). There is a number of responsible factors retard in increasing the agricultural efficiency in different corners of the country. West Bengal in general and Hugli District in particular is not an exception. Among them misuse and under use of agricultural land, age-old techniques with outdated implements, keeping land away from chemicalization and rationalization, low living standards of peasants, defective tenure system are altogether as well as individually accountable for lower agricultural efficiency in West Bengal in specific. Though Hugli is one of the agriculturally developed districts in the state, since there are some pockets whose low level of efficiency put hindrance in overall development as well as economy in this district. This study highlight on such an issue and their probable causalities at block level in the field of agriculture.

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Study Area

The district Hugli is lying in between 22°39'32" North and 23°07' 20" North, 87°30' 20" East and 88° 30' 15" East longitude. The district is bordered on the north by the districts of Bankura and Barddhaman, on the south by the district of Haora, on the east by the Bhagirathi (Hugli river) demarcating the district of Nadia towards north and North Twenty Four Parganas district east and the west and south-west by the district of Medinipur (Fig. No. 1). This district has a total area of 3,573.30 Sq. Kms and it ranks 13th among all the districts

of West Bengal. Hugli has 18 C.D. Blocks with the District Headquarter in Chinsurah. Almost the entire area except the triangular portion, west of the river Dwarkeswar comprising the Goghat I and II blocks of the district is a flat alluvial plain intersected by a number of sluggish rivers and streams. On the vast aggradational surface the only marked topographical variation are those associated with the numerous shift and diversions of rivers, an unequal aggradation rendering some surface above flood level and other below water table (Koley, 1984). The district is well watered by a number of rivers which include large rivers like Bhagirathi, the Damodar and the Rupnarayan and the smaller streams like the Behula, the Kana nadi, the Saraswati, the Mundeswari etc. It is enriched with fertile alluvial soil of two different types, older alluvium and the newer alluvium.

The older alluvium occurring in the western most triangle is the detritus of Bankura upland being partly laterized and deficient in nitrogen, humus and lime. The new alluvium varies in texture from sandy to clayey. The soil as the whole is fertile and is periodically enriched by fresh deposit of silt from the overflow of the rivers. The modified Gangetic monsoon climate of the district is characterized by moderate temperature due to the nearness of the Bay of Bengal with the cold weather means around 17.7°C and hot weather means 26.67°C to 29.44°C. The rainfall is copious. The average annual rainfall in the district is 1445mm. The annual rainfall in the district varies from 1408mm in the west to 1778mm. in the east (Koley, 1984). Thus the ecological condition of the district has given priority to the agricultural occupation of the people as it is reflected from the percentage of people engaged in agriculture to the total population and also from the acreage covered by cultivation. According to 2001 census almost 39.26 % of the working population is engaged in agricultural activities. In the year 2007-08 the cultivated land (Net Sown Area) accounted for 219.91 thousand hectares i.e., 70.17% of total area. More than half of these areas are multiple cropped land. In the year 2001, net area irrigated accounted 158.14 thousand hectares i.e., 72.16% of net area sown (NSA). Thus the district in spite of its highly industrial particularly in the eastern flanks the producer of the number of crops, some of which occupy significant role in West Bengal. The prominent crops in order of importance are aman, boro, jute, potato, oil seeds, aus, pulses and wheat.

Table 2: Some Information of Hugli District

Total Area	3149 Sq.Km.
Total Population	5041976 (2001)
Population Density	1601 per Sq. Km.
Percentages of Cultivators	14.95
Percentages of Agricultural Labourers	24.31
Net Sown Area	219.91 (2007-08)
Area irrigated by different sources	345.150 (' 000 Hec)
Yield Rate of Rice	2800 Kg. per Hec.

Source: Census of Hugli District, 2001 and District Statistical Handbook, 2008

Objectives of this Study

The main objectives of the present study are as follows:

- To measure the agricultural efficiency of various crops and also their block level variations.
- To measure the agricultural productivity in terms of different crops and also find out the productivity zones at different levels (e.g., low, moderate, high etc.).
- To examine the probable causality that is the determining factors (e.g., physical, economic and organizational etc.) behind such levels of efficiency and productivity.
- To suggest measures for the improvement of efficiency and productivity.

DATABASE AND METHODS

There are various scholars who have contributed different ideas, methods and techniques to measure the agricultural productivity, like Kendall (1939), Shafi (1960), Bhatia (1967), Khusro (1964), Jasbir Singh (1979) and Sapre and Despanday (1964). The areas which experiences high land productivity may always have been leading agricultural regions, as witnessed by development of irrigation facilities (Dayal, 1984). This entire work is mainly based on secondary data i.e., collected from District statistical Handbook of Hugli District (2008), District Gazetteer of Hugli District and many others literature and research papers. In this purpose to measure the agricultural efficiency, methods proposed by S.S. Bhatia (1967) have been introduced. There are two advantages which are apparent by using this method. This is as follows:

$$ly_n = (y_1 / y) \times 100$$

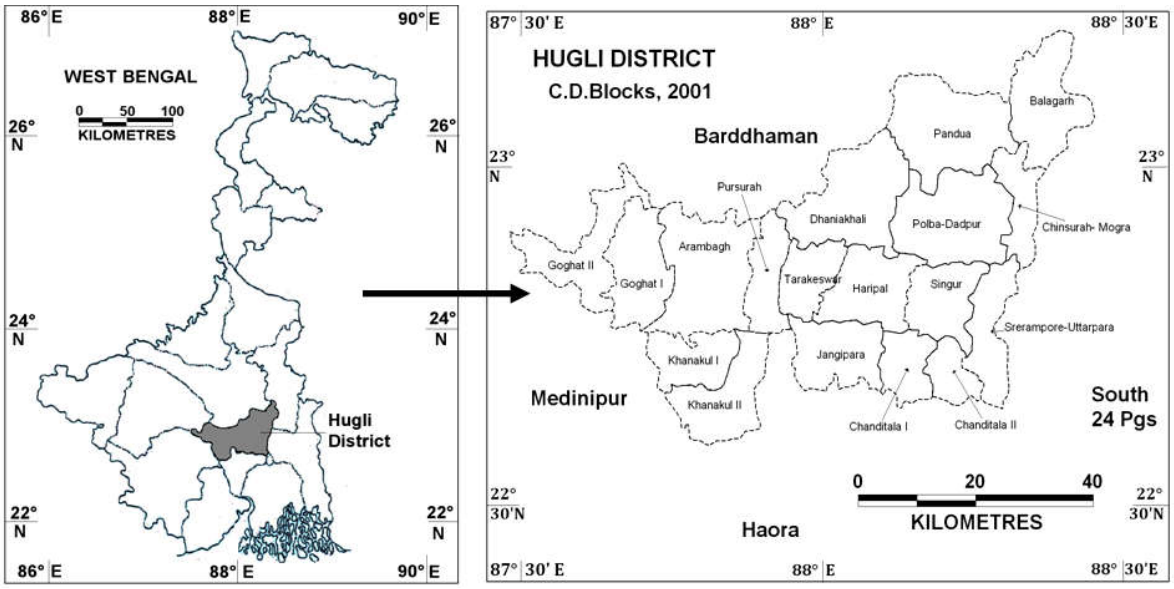


Figure 1: Location Map of the Study Area

Where, ly_n= percentage yield of crop n
y_1= yield of individual crop in an areal unit.
y = yield of individual crop in the total area.

$$Ei = (ly_1c_1 + ly_2c_2 + ly_3c_3 + \ldots\ldots + ly_nc_n)/ (c_1+c_2+c_3+\ldots..+c_n)$$

Where, Ei = Agricultural Efficiency Index (AEI)
$ly_1, ly_2, ly_3 \ldots\ldots ly_n$ = The indices of different crops.
$c_1, c_2, c_3 \ldots\ldots c_n$ = Percentages of crop area to total cropped area.

On the other hand to measure the productivity of the regions, techniques used by M.Hussain (1976) to delineated agricultural productivity regions of the Sultej-Ganga Plains, have been used. In this method production value in money of all crops per unit area were divided by the production value in money of the region as a whole. In words the formula may be written as:

Productivity Index = {(Production value in money of all the crops in an areal unit/ Total cropped area in an areal unit) ÷ (Production value in money of all the crops in the region/ Total cropped area in the region)} × 100

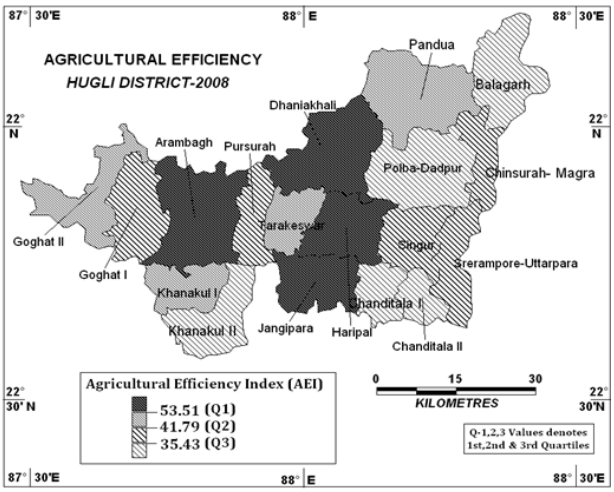
For this purpose areas and production converted in terms of money at the then prevailing average price of the crops like paddy, wheat, jute, potato etc. grown in each block have been taken into consideration. The result thus obtained were examined in relation to the total output converted into money of all crops considered for the whole district divided by the total area under all crops of the same and then it was multiplied by hundred for deriving the result into percentages. For determination of probable causality behind variation in agricultural efficiency and productivity and more specifically overall agricultural development, Principal Component Analysis (PCA) has been worked out based on different factors behind agricultural development. These are percentages of net sown area to total area, percentages of irrigated area to total cultivable area, cultivators to total workers, agricultural labourer to total worker, numbers of fertilizer store, seed store, fair price shops, bank and credit facility.

RESULTS AND DISCUSSIONS

Regional Variation in Agricultural Efficiency

On the basis of agricultural efficiency statistics determined by the above mention formulas based on the yield of eight major crops produced in the district four efficiency classes have been identified. These classes are based on Median and Quartile Ranges, in which after determination of Median, Quartile 1 and 3 of any set of data can be divided into four parts. These are as follows:

- Very High efficiency areas: The first category area comprises the blocks of Arambagh, Dhaniakhali, Haripal and Jangipara where the efficiency values ranges from 53.51 to 60.76.In these blocks per hectare production of mentioned eight crops is higher than others. Among them in Arambagh and Dhaniakhali more than 75% of lands are fall under the categories net sown area and 70% of cultivated areas (also in Jangipara and Haripal) enjoy the irrigated facilities from different sources.
- High efficiency areas: Under this category blocks are Pandua, Goghat-II, Tarakeswar and Khanakul-I which have efficiency level of 41.8 to 53.51. Though high level of irrigated areas as well as sown area in Pandua and Tarakeswar since moderate level of engagement in agricultural activities, less area under irrigation (e.g., 40.77 % in Khanakul-I etc.), unfertile laterite soil (especially in Goghat-II) are the prime factors behind decreasing efficiency level.
- Moderate efficiency areas: Goghat-I, Pursurah, Singur, Srerampore-Uttarpara, Chinsurah-Mogra are fall under this categories (values ranges from 35.43 to 41.79). Major areas are covered by urban to semi –urban settlement in Chinsurah-Mogra and Srerampore-Uttarpara blocks. So net sown area and irrigated area very few in this two regions (NSA 61.77 and 53.45 % respectively). Though Pursurah have a high ranges of net sown as well as irrigated area (84.62 and 95.68% respectively) since there are moderate level of efficiency,
- Low efficiency areas: Under this worst situation blocks like Balagarh, Polba-Dadpur, Khanakul-II, Chanditala-I and II are fallen where efficiency values ranges from 31.32 to 35.43. Low level of irrigation as well as net sown area, water logging (especially in Khanakul-II), Arsenic Contamination in ground water (e.g., Balagarh) and low level of engagement in agricultural activity (e.g., 11.54% in Chanditala-II) are the principal causes behind low level of efficiency.



(Source: Data from District Statistical Handbook, 2008 and prepared by author

Figure 2: Block-level Agricultural Efficiency in Hugli District

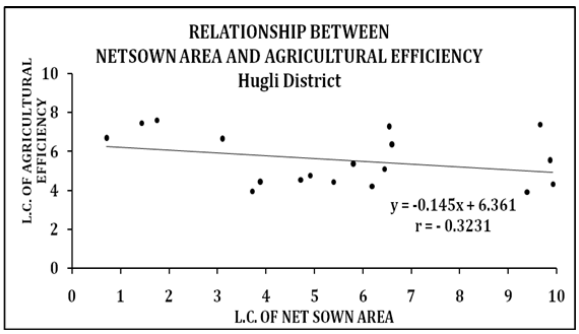
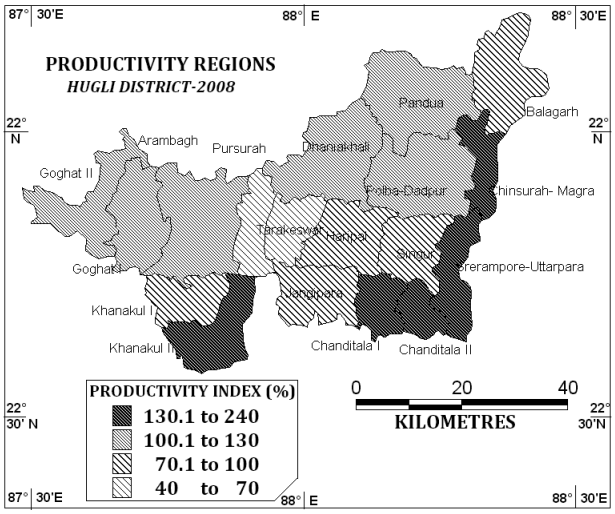


Figure 2: Negative Relationship between Net Sown Area and Agricultural Efficiency at block level in Hugli District

In addition to the calculation, location coefficientat block-level of both net sown area and agricultural efficiency have been calculated. Figure 3 shows the negetive relationship between these two aspects where product moment correlation value is -0.3231. This result clearly depicts that there are other factors too which may idividually or collectively control the variation level of efficiency at block level. Which become the subject for determination.

Productivity Regions

With the help of mentioned method to measure productivity eighteen blocks of Hugli District are categorized in four classes i.e., Very High, High, Moderate and Low. This area as follows:



(Source: Data from District Statistical Handbook, 2008 and modified-prepared by author)

Figure 4: Block-level Productivity Index (%) in Hugli District

Determination of Principal Factors in Agricultural Development

The agricultural practices, efficiency and their productivity are closely determined by the geo-climatic, socio-economic as well as cultural-political factors. These factors individually and collectively have their impact on the whole agricultural system (i.e., cropping pattern, agricultural efficiency, productivity etc.) of any area. Here in case of Hugli district some selective parameters are taken into consideration to evaluate the level of agricultural development. These are agricultural efficiency index, productivity index, percentages of net sown area to total area, percentages of irrigated area to total cultivable area, numbers of deep tube wells, percentages of rural population to total population, percentages of cultivators to total workers, percentages of agricultural labourers to total workers, number of fertilizer depots, number of seed stores. A multivariate analysis seems to be quite necessary to find out the relative importance of each variable. Preparation of Correlation Matrix and Principal Component Analysis (PCA) are the standard devices in this investigation. From the Correlation Matrix, we can easily find out the nature of bi-variate relationship of number of variables. The Principal Component Analysis provides the basis of sorting out a number few components which account for the major amount of explained variation of the variables. Rests of the components are of negligible importance. Again the importance of the variables in order of their ranking can be done statistically through PCA. With the 42% explanation in the first principal component analysis, variable C (Percentages of Net sown area), F (Percentages of rural population) and H (Percentages of agricultural labourers) become the guiding variables of this whole agricultural system. So in this stage working population have a great influence to control this system. In the second stage (56.22% explained), variable B (Productivity index) and E (Number of deep tube wells) have high positive influence where variable I (Number of fertilizer depots) has negative influence to control the whole system. So in this stage infrastructural component play the dominant role. In the third stage with 68.32% explanation only variable J (number of seed stores) has positive and G (percentage of cultivators) has negative impulse to control this system. As a result, it is found that not only a single parameter rather multiple factors i.e., economic, demographic as well as infrastructural have their influence in overall control as well as in block-level control of this agricultural system.

The level of development also been assessed in spatial context through mapping with prin score values extracted from two stages of principal component values (Fig No. 5 & 6)

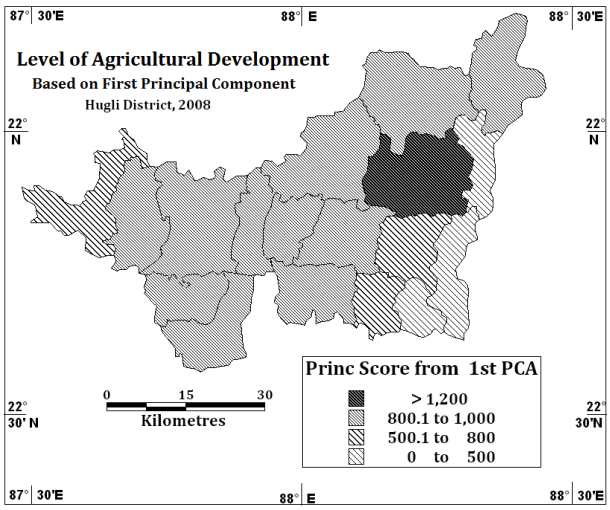


Figure No. 5

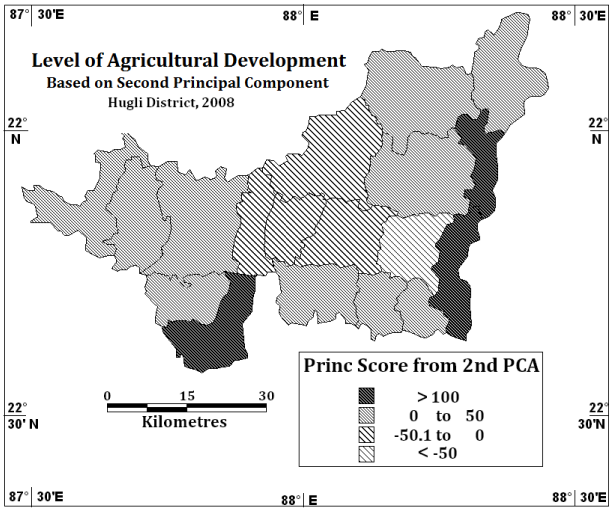


Figure No. 6

Table 2: Productivity Index (Calculated by Author)

Degree of Productivity	Index Value in Percentages	Number of Blocks	Name of the Blocks
Low	40-70	2	Pursurah, Tarakeswar
Moderate	70.01-100	5	Jangipara, Haripal, Singur, Balagarh, Khanakul-I
High	100.1-130	6	Goghat-I, Goghat-II, Arambagh, Dhaniakhali, Pandua, Polba-Dadpur
Very High	> 130	5	Khanakul-II, Chinsurah-Mogra, Srerampore-Uttarpara, Chanditala-I &II

Table 3: Pearsonian Product Moment Correlation Matrix

Variables	A	B	C	D	E	F	G	H	I	J
A	1.00	-0.32	0.33	0.04	-0.08	0.36	0.28	0.42	0.00	0.34
B		1.00	-0.18	-0.32	0.05	-0.51	-0.33	-0.33	-0.32	-0.23
C			1.00	0.43	0.38	0.81	0.71	0.67	-0.02	0.36
D				1.00	0.00	0.30	0.26	0.52	0.10	0.15
E					1.00	0.36	0.20	0.46	-0.01	0.45
F						1.00	0.76	0.70	0.15	0.42
G							1.00	0.46	-0.03	-0.01
H								1.00	-0.09	0.73
I									1.00	0.02
J										1.00

(A= Agricultural efficiency index, B= Productivity index, C = Percentages of Net sown area to Total Area D= % of Irrigated area to total cultivable area, E= Number of deep tube wells, F= Percentages of rural population to total population, G = Percentages of cultivators to total workers, H= Percentages of agricultural labourers to total workers, I= Number of fertilizer depots, J= Number of seed stores**)**

Table 4: Extraction of Principal Components with Cumulative Percentages of Variance

Variables	A	B	C	D	E	F	G	H	I	J
PC1 (41.48%)	0.49	-0.51	0.85	0.50	0.44	0.91	0.70	0.89	0.07	0.60
PC2 (56.22%)	-0.20	0.61	0.09	-0.27	0.65	-0.11	-0.20	0.24	-0.54	0.41
PC3 (68.32%)	0.22	-0.30	-0.33	-0.06	0.09	-0.13	-0.58	0.15	0.45	0.61

PC 1, 2, 3 = Principal Components 1, 2, 3

Conclusions

Aim of this section is to analyze the backwardness in agricultural production and its efficiency of some blocks in Hugli district and try to make some suggestions for betterment of this agro-based economy. There is sharp dichotomy in the spatial implication agricultural efficiency and productivity. The high efficient regions have low to moderate productivity and vice versa. It is because of high productivity regions give attention to multi crop agriculture and make parity with demand in market (i.e., commercial farming) where as high efficient regions give more attention to subsistence agriculture which emphasize the single crop farming and result low to moderate productivity in terms of money. So farmers of these blocks are unable to convert their yield of crops into monetary output after fulfill their domestic demand. On the contrary, blocks having low efficiency have high productivity due to better market facility, market price, accessibility to markets and better storage facility. So, there is unevenness between Agricultural production and its monetary conversion. In the western part blocks like Goghat-I and II and in south Khanakul-I and II are facing low level of production due to lateritic soil and rugged topography and acute problems of irrigation and water logging. Since Khanakul I and II blocks have high fertile land, better water harvesting techniques may enhance the agricultural output in these regions. Multiple cropping and orchard farming may also be the alternative avenues to increase agricultural production mainly in the areas of moderate to high irrigation practices (Singur, Haripal, Tarakeswar, Chanditala) and in the urban to suburban areas (Chinsurah-Mogra, Srerampore-Uttarpara, Chanditala II) respectively. For overall development of agricultural sector these all measures are earnestly needed.

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